Steel Structures

Dr. Haluk Sesigür
I.T.U. Faculty of Architecture
Structural and Earthquake Engineering WG

Bridge on Severn river was built in 1779

Historical bridges are made of iron/steel in Venice

Historical building in İzmir (Masonry walls with interior steel/iron structural system)

Figure 2.1
National Stadium, Beijing, China, Herzog & De Meuron, 2008. An elevation of the stadium.

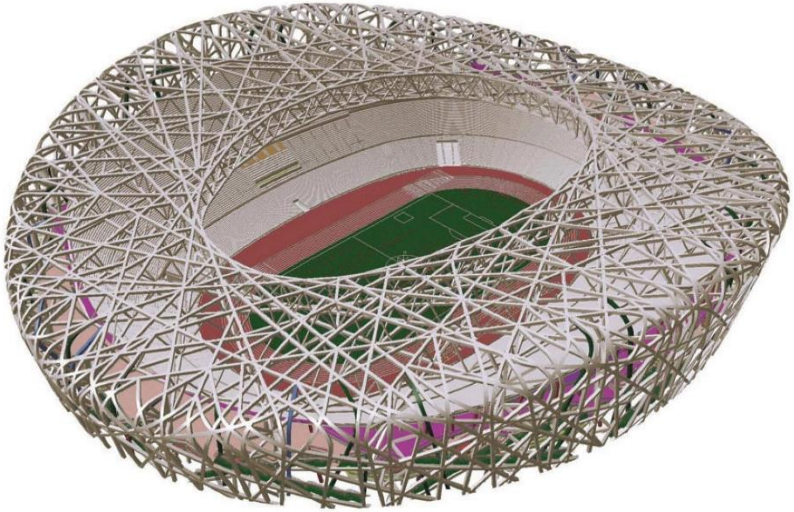


Figure 2.2
The perimeter steel structure wraps around the inner concrete bowl (Arup).

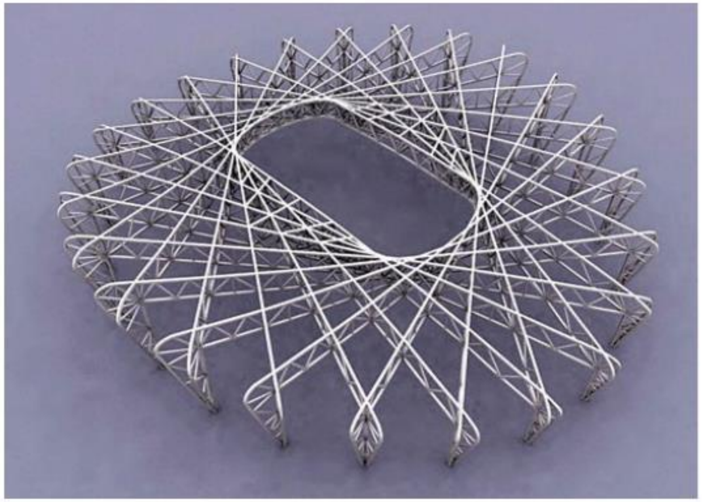
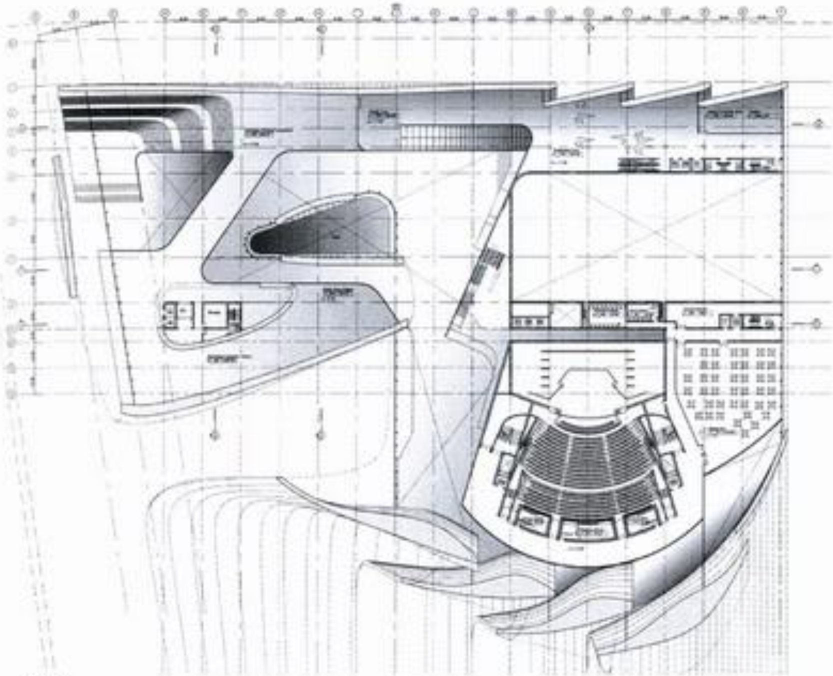


Figure 2.3
A physical model of the perimeter steel and roof gravity-resisting portal frame structure (Arup).

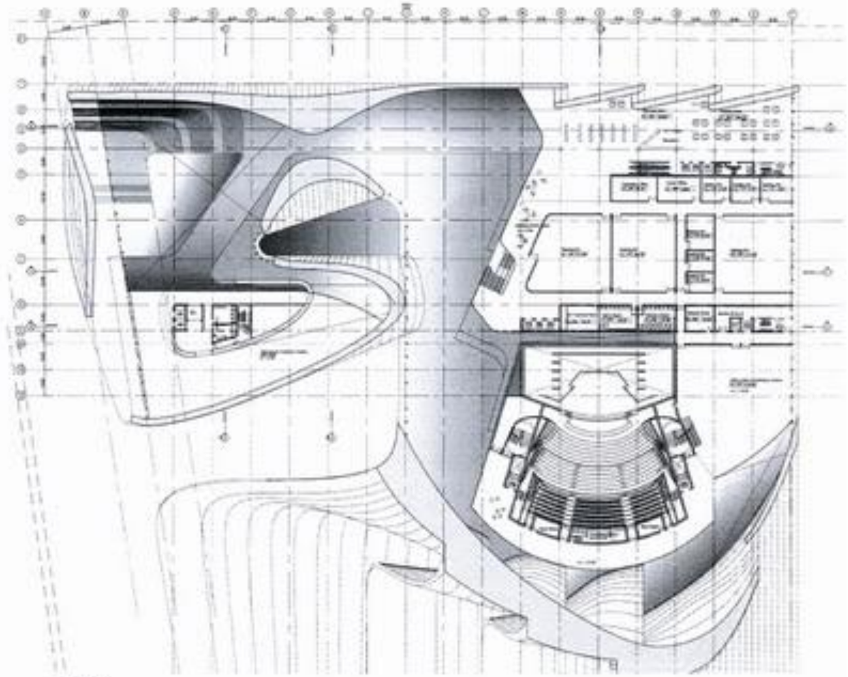

庆祝北京奥运会倒计时100天群众马拉松活动暨三星电子杯2008年北京国际长跑节
三星电子
SAMSUNG
One World One Dream

Heydar Aliyev Cultural Center (2007-2012) in Baku, designed by Zaha Hadid Architects

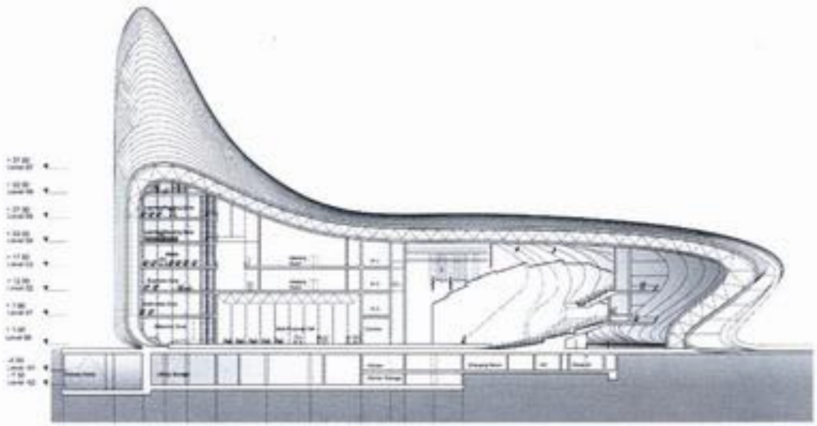

AZERBAIJAN PHOTO



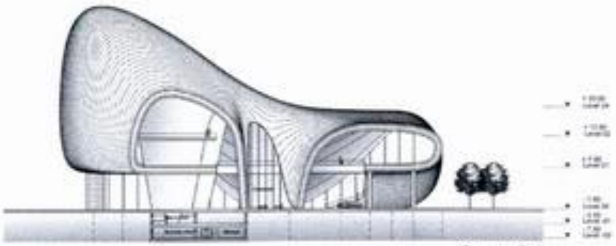
Level 1



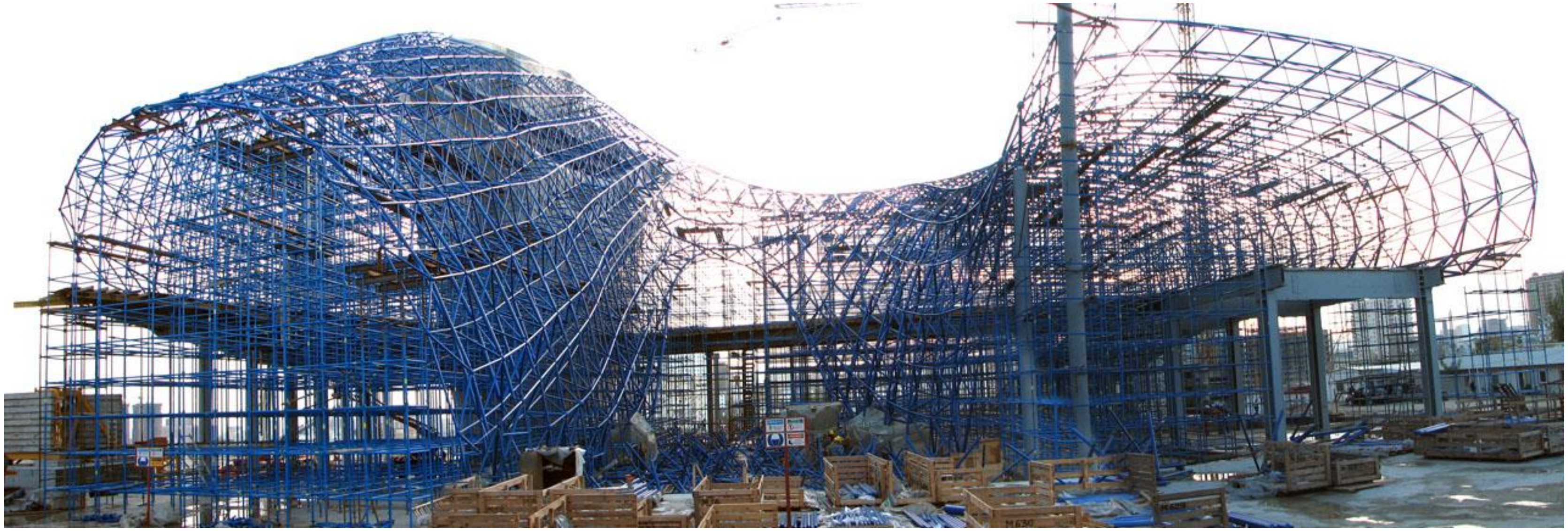
Level 2

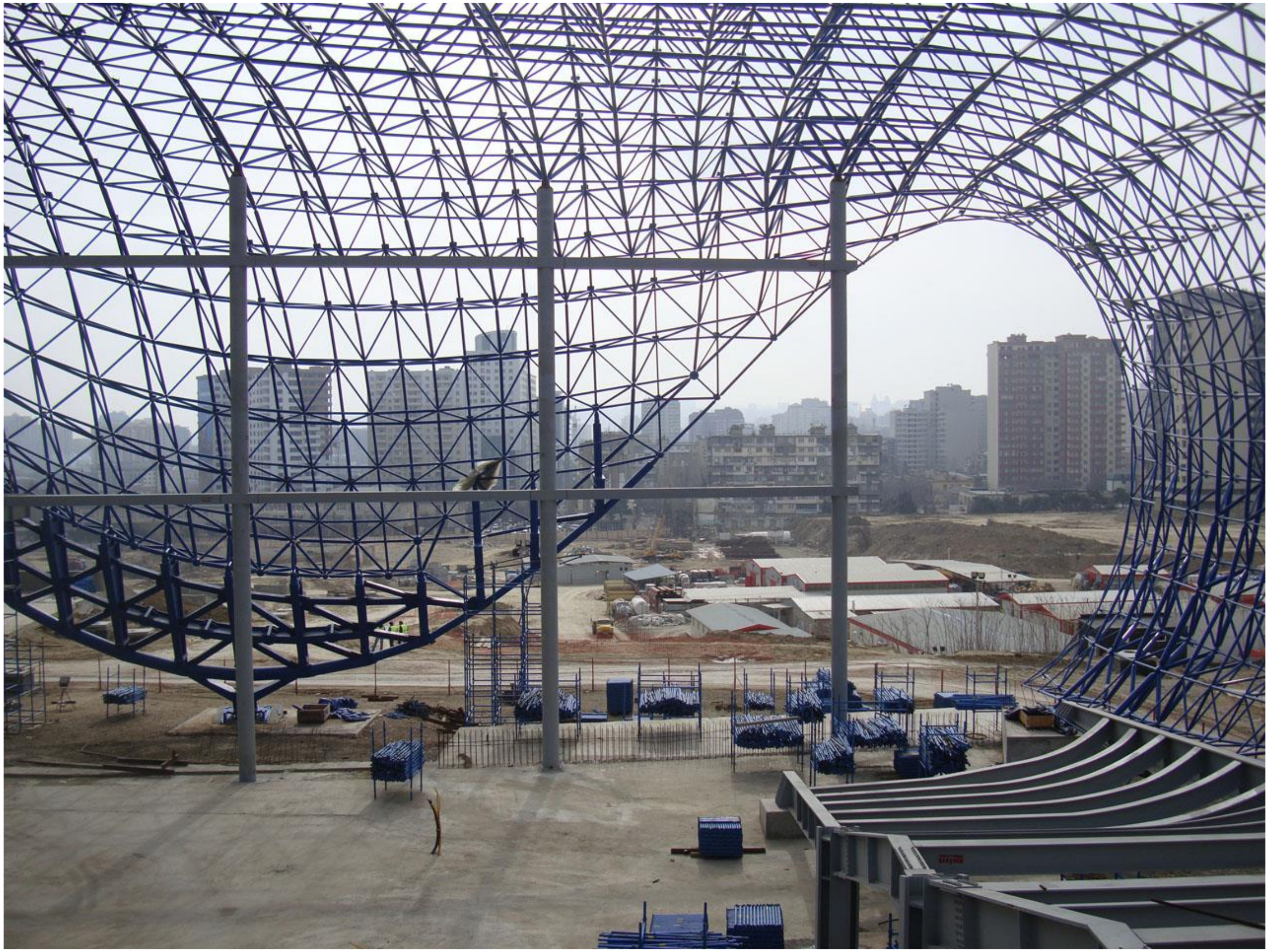


◁*Section A-A*



Section E-E






JLG
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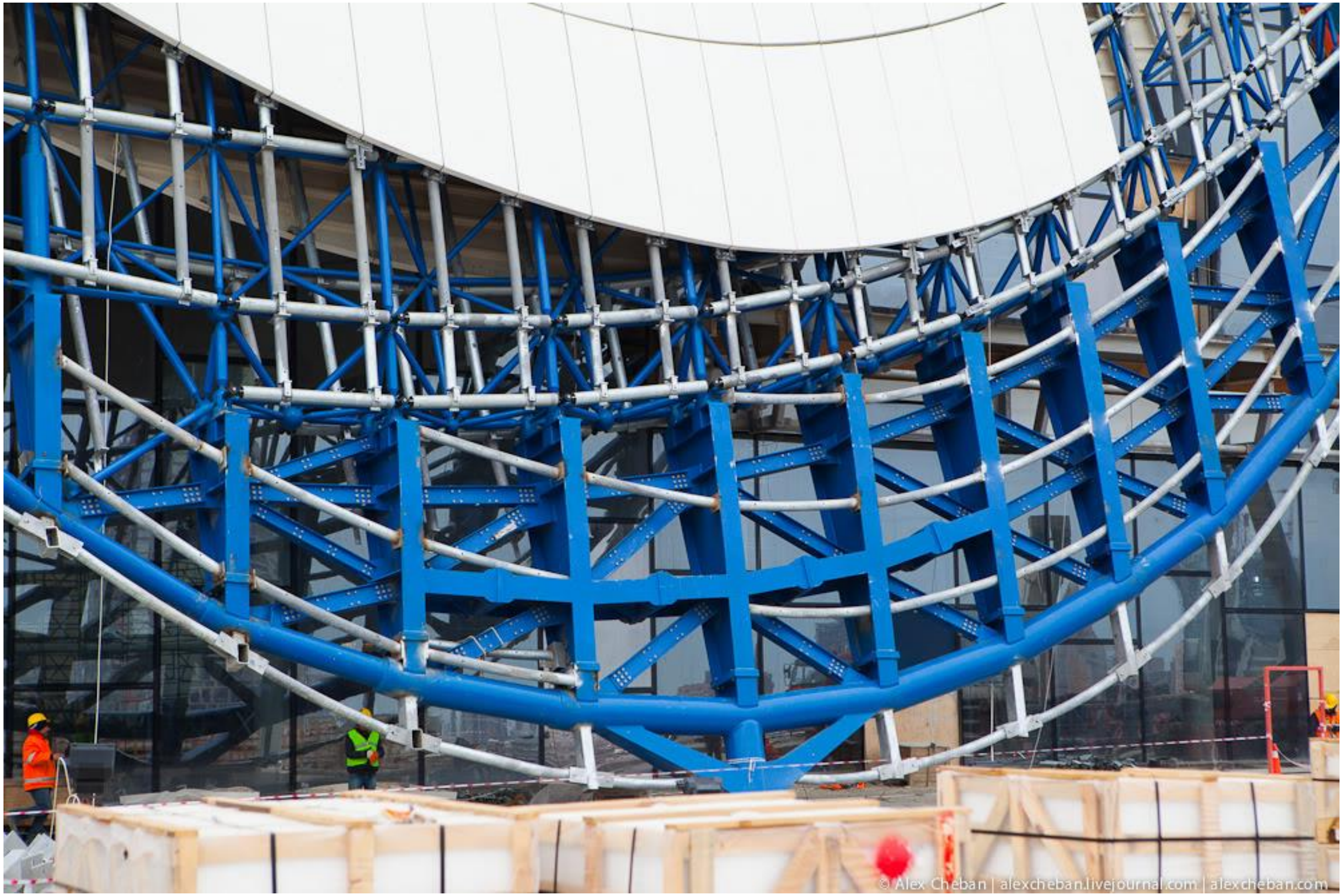
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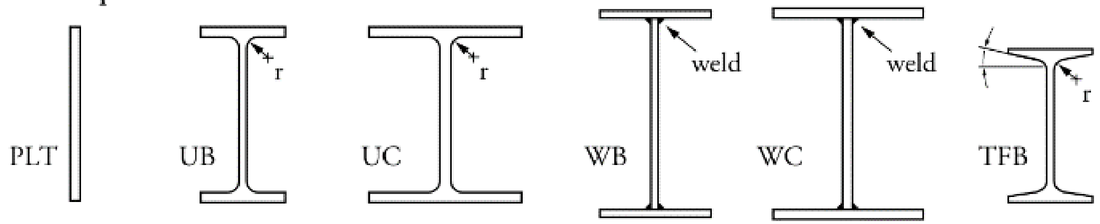
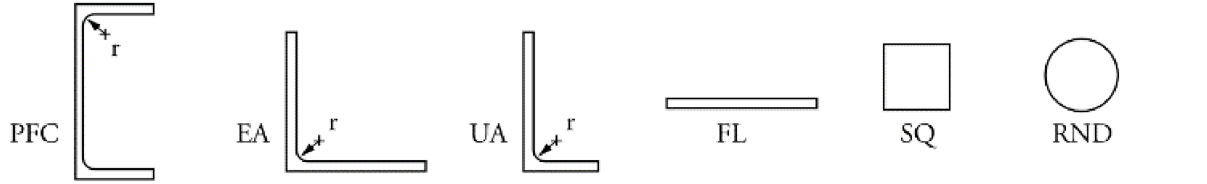
(a) Hot-rolled plates and I-sections



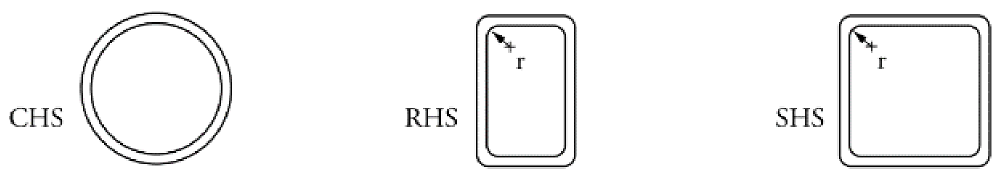
PLT = Plate
UB = Universal Beam
UC = Universal Column
WB = Welded Beam (from HR Plate)
WC = Welded Column (from HR Plate)
TFB = Taper Flange Beam
weld = fillet/deep penetration weld
r = fillet radius from manufacturing process

(b) Hot-rolled channels, angles and bar



PFC = Parallel Flange Channel
EA = Equal Angle
UA = Unequal Angle
FL = Flat (or Flat Bar)
SQ = Square (or Square bar)
RND = Round (or Round Bar)
r = fillet radius from manufacturing process

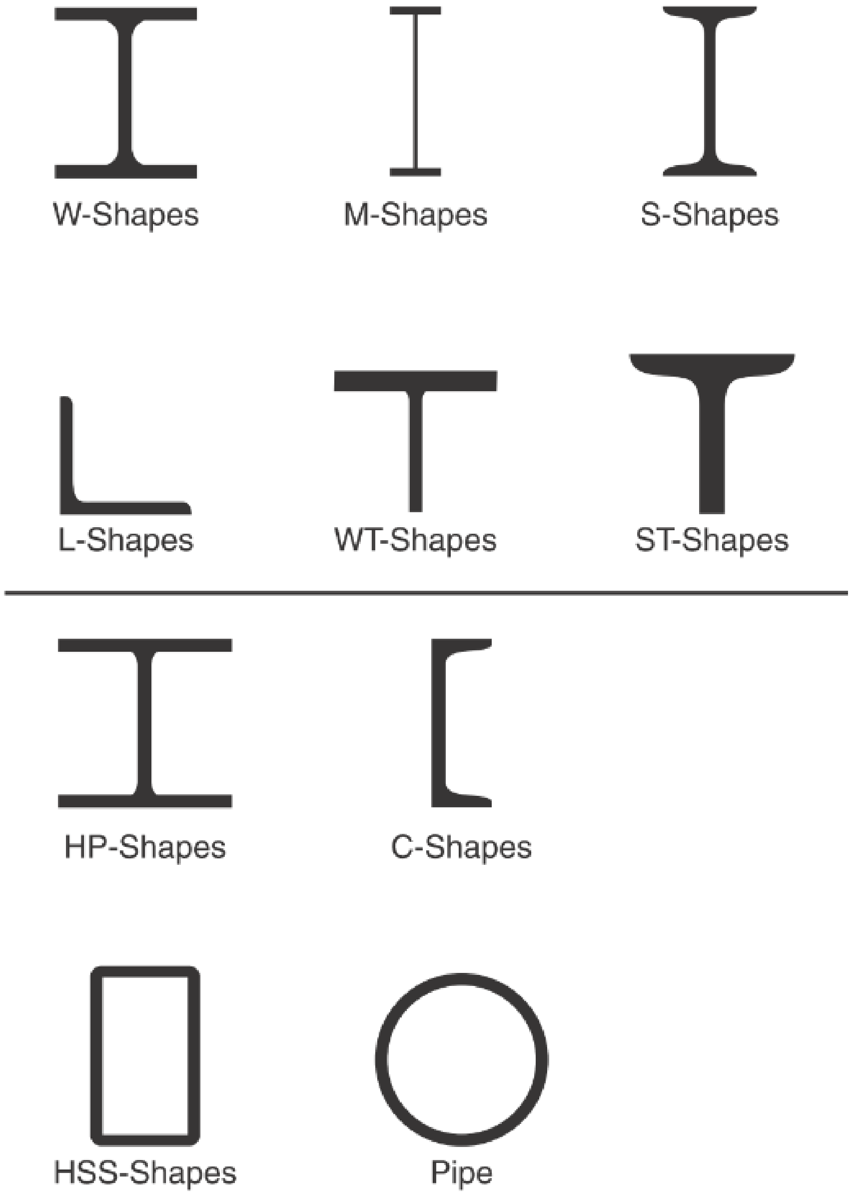
(c) Cold-formed structural hollow sections



CHS = Circular Hollow Section
RHS = Rectangular Hollow Section
SHS = Square Hollow Section
r = corner radius

Figure 2.1 Fundamental structural steel elements: standard sections and plate

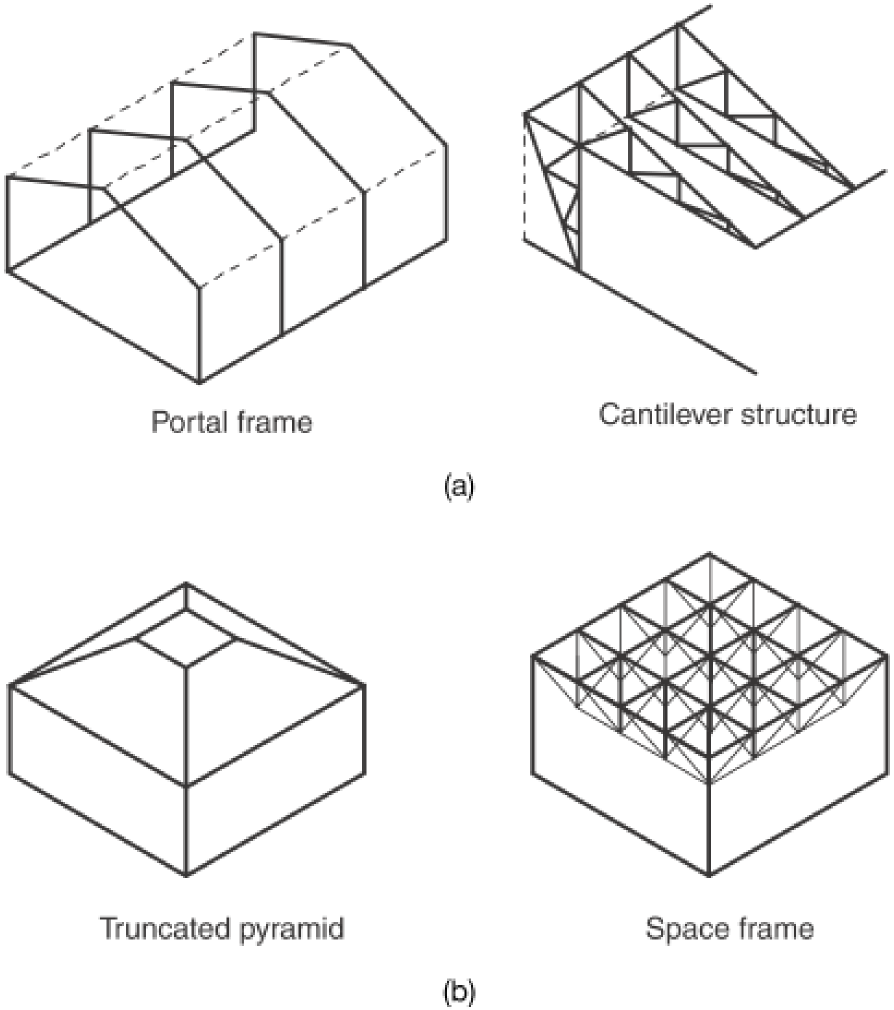
Steel Designers Handbook, B.Gorenc, R.Tinyou, A.Syam



Shape	Designation
Wide flanged beams	W
Miscellaneous beams	M
Standard beams	S
Bearing piles	HP
Standard channels	C
Miscellaneous channels	MC
Angles	L
Tees cut from W-shapes	WT
Tees cut from M-shapes	MT
Tees cut from S-shapes	ST
Rectangular hollow structural sections	HSS
Square hollow structural sections	HSS
Round hollow structural sections	HSS
Pipe	Pipe

Table 1.1 Rolled Steel Sections

Steel Structures Design ASD/LRFD, A.Williams



3.1 Examples of various forms of two- and three-dimensional frames to form enclosures: (a) two-dimensional frames (repeated to form a three-dimensional structure); and (b) three-dimensional frames (repeated parts relying on mutual support)

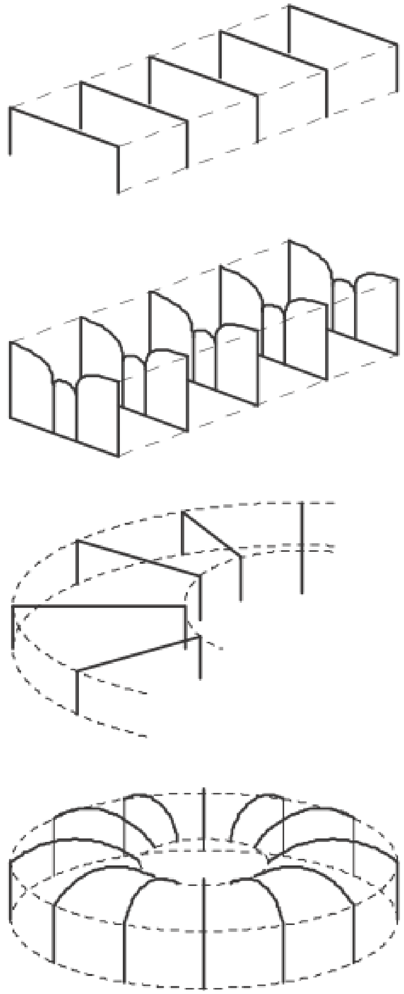
Architectural Design in Steel, P.Trebilcock, M.Lawson

3.2.1 *Repetition of frames*

An exposed structure establishes a dominant rhythm in the elevational composition. More often than not, it is a simple and singular rhythm derived from the equal spacing of the primary frames.

3.2.2 *External frames*

By selectively exposing or concealing structural members, emphasis can be given either to the primary frames, or to the wall and ceiling planes which define the building volume.



3.3 Various illustrations of identical frames repeated at intervals

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3.4 Crown Hall: external portal frame (architect: Mies van der Rohe)

3.5 Lufthansa Terminal, Hamburg Airport (architect: Von Gerkan Marg & Partners)

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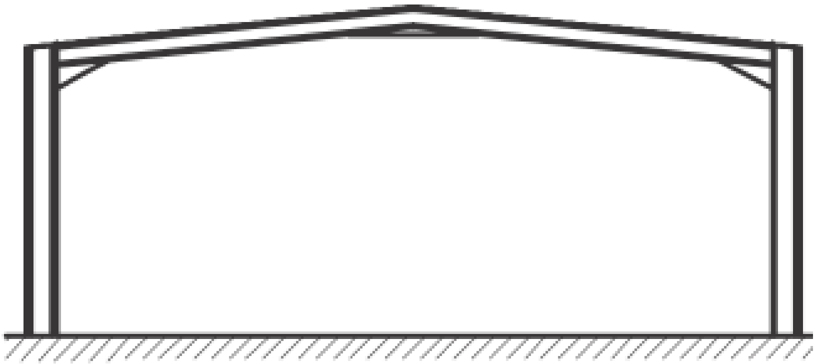
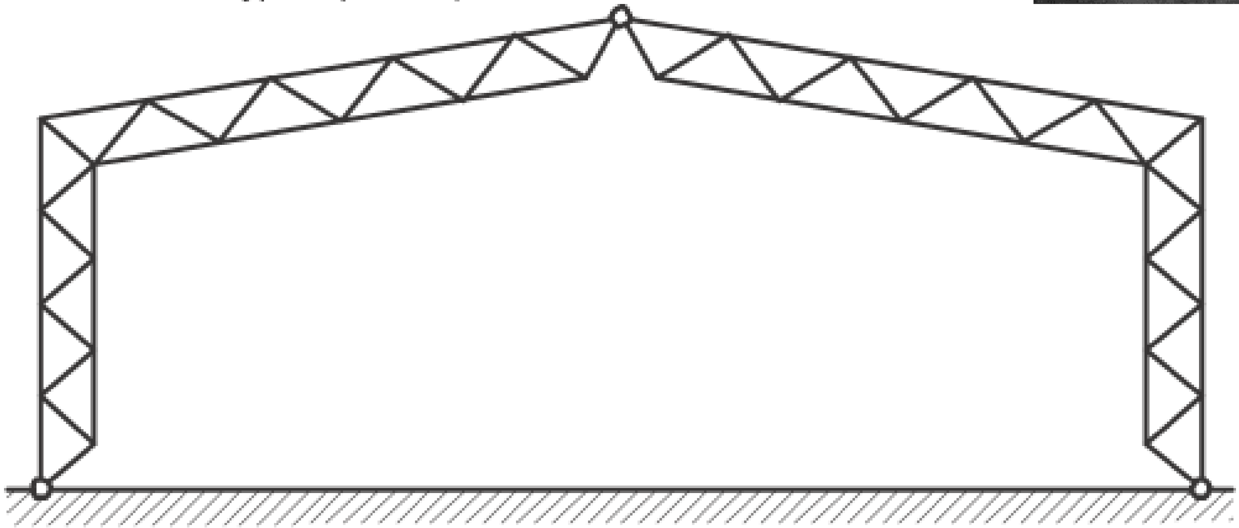


(a) Standard portal (typical span 15 m to 45 m, typical pitch 6°)

3.7 Portal frame expressed internally behind a glazed-end elevation of a building for Modern Art Glass (architect: Foster and Partners)



(b) 3 pinned lattice portal (spans up to 80 m)

3.8 Typical portal structures using a variety of members

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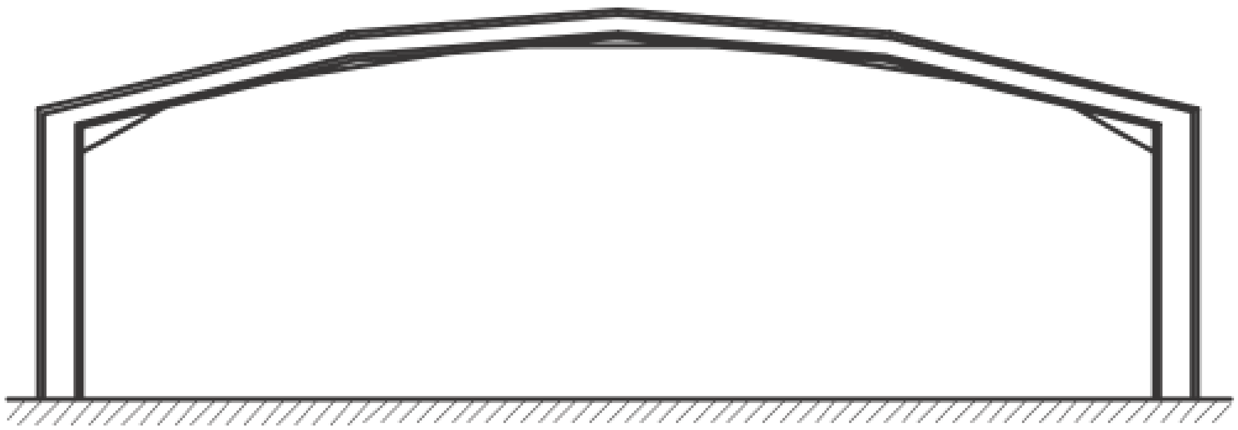
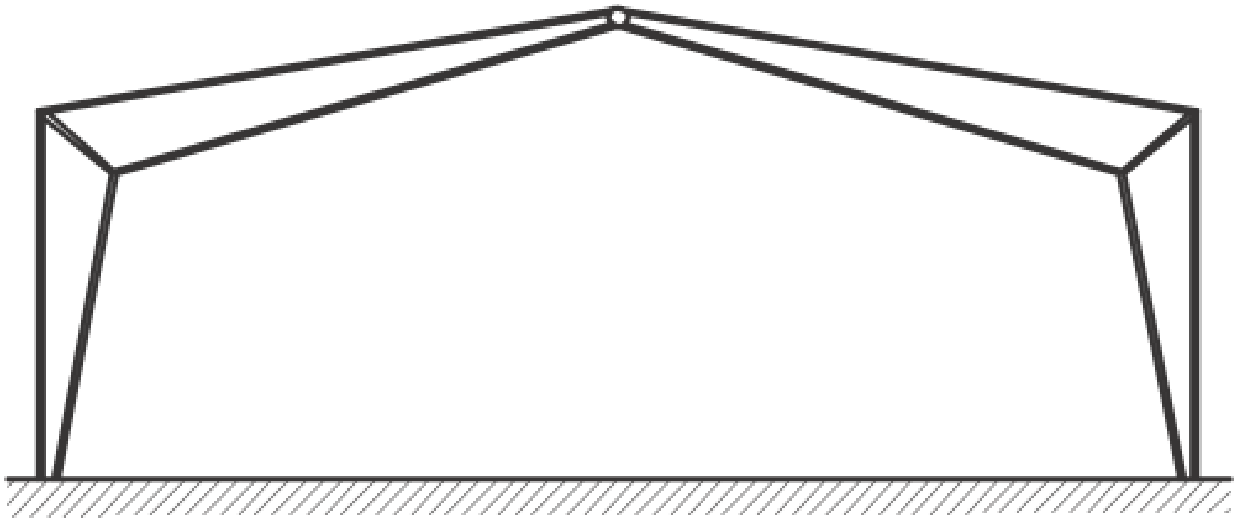


(c) Mansard portal (spans up to 60 m)



(d) Tapered portal fabricated from plate (spans up to 60 m)

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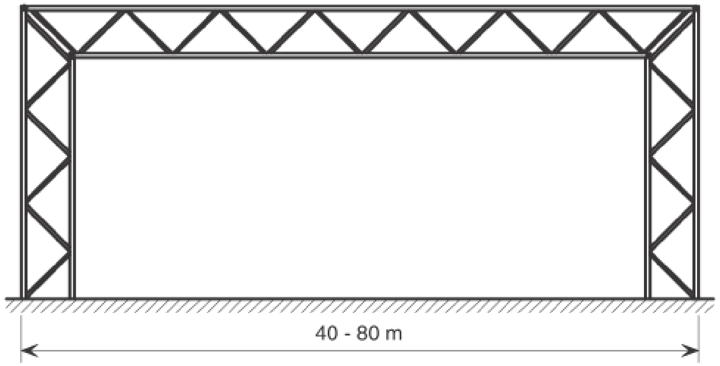
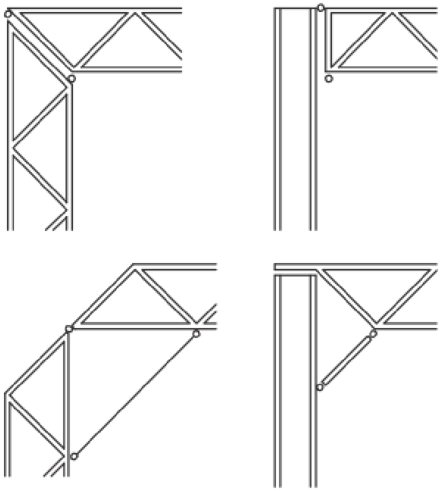


The **Sainsbury Centre for Visual Arts** is an art gallery and museum located on the campus of the University of East Anglia, Norwich, England. The building, which contains a collection of world art, was one of the first major public buildings to be designed by the architect Norman Foster, completed in 1978.[1] The building became grade II* listed in December 2012. (wikipedia)

3.9 Articulated lattice portal structure (often using tubular sections)



3.13 Rigid connections achieved by pinned connections between the elements

Sainsbury Centre for Visual Arts – Foster + Partners, Norwich, UK, 1974-1978

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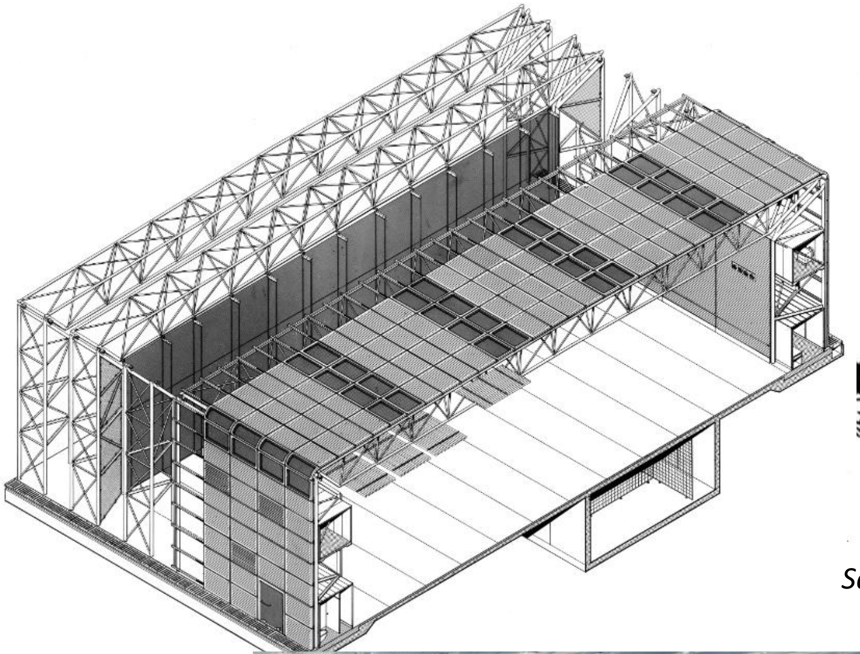
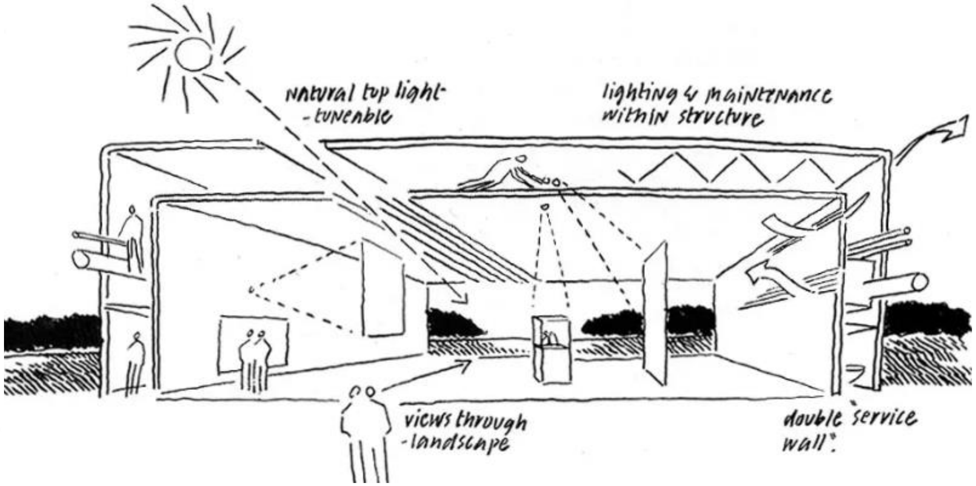
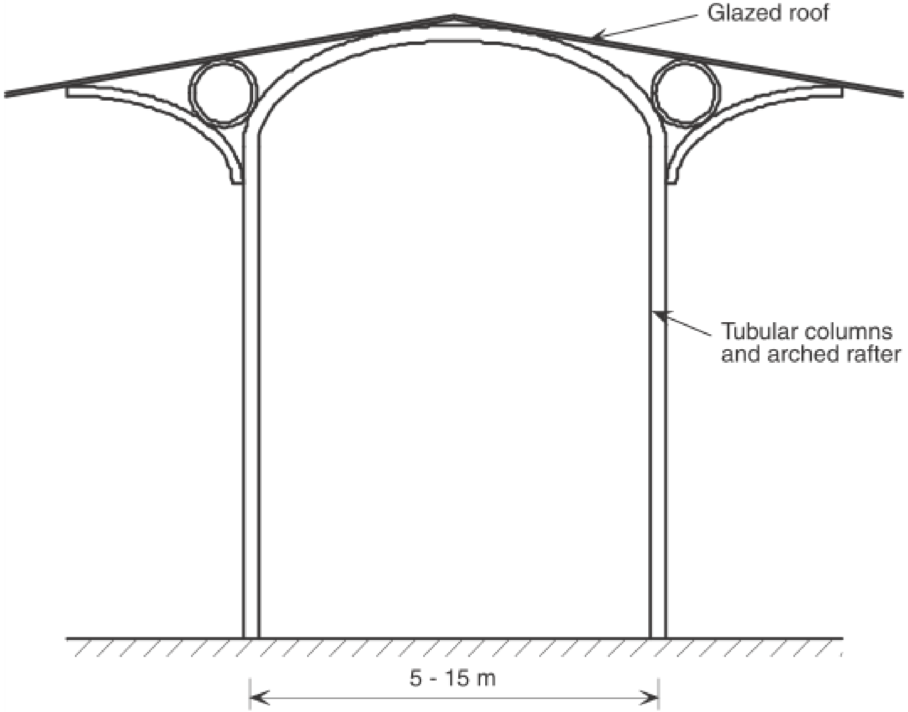




Sainsbury Centre for Visual Arts – Foster + Partners, Norwich, UK, 1974-1978



3.10 Arched portal using tubular sections

4.26 Curved roof at Princes Square, Glasgow (architect: Hugh Martin & Partners)

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4.1.2 *Perforated sections*

Castellated or cellular beams are examples of longer span members which have large openings within their depth.[12] These beams achieve the benefits of greater structural efficiency by increasing the section depth for a given use of steel, and provide multiple routes for services. Cellular beams have architectural appeal by their apparent lightness and distinctive appearance in long-span roofs and floors, as in Figure 4.2.

4.2 Curved cellular beam used for architectural effect

4.4 Cellular beam shows integration of circular service ducts

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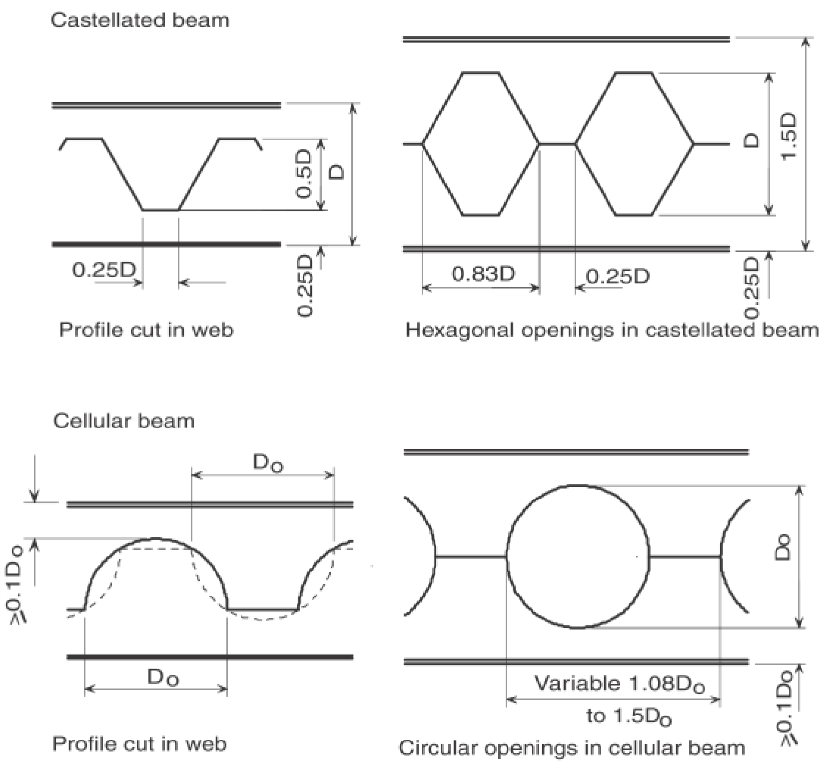
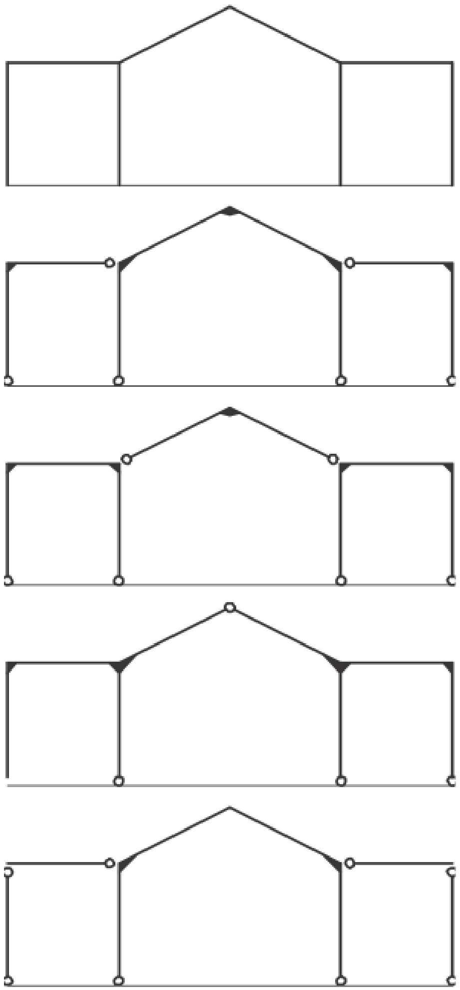
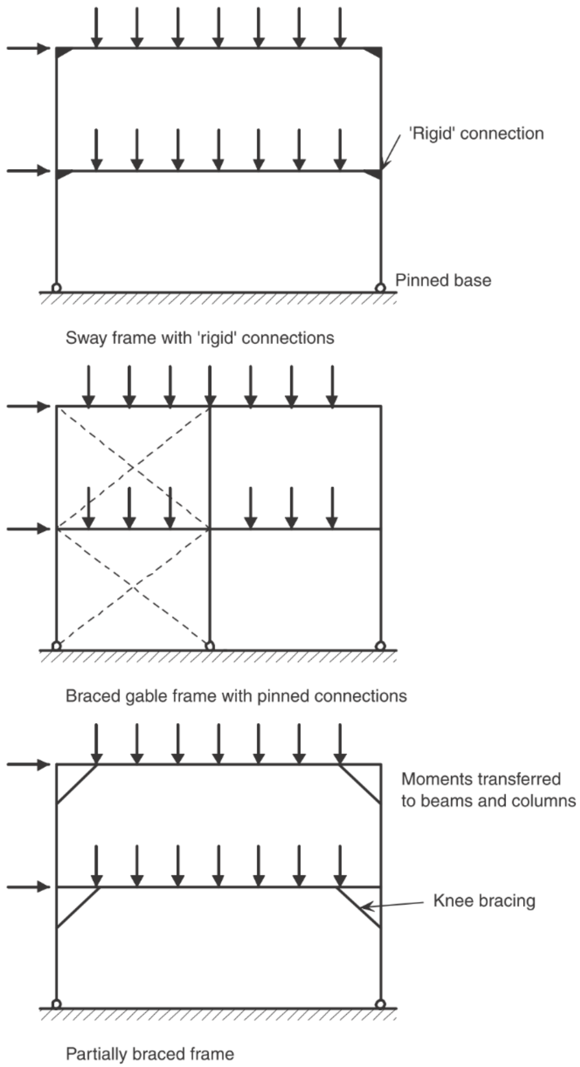


3.2 Portal-frame structure created using cellular beams

Architectural Design in Steel, P.Trebilcock, M.Lawson



3.15 Different overall forms of the frame by varying type and location of pinned connections



3.17 Examples of rigid and braced frames

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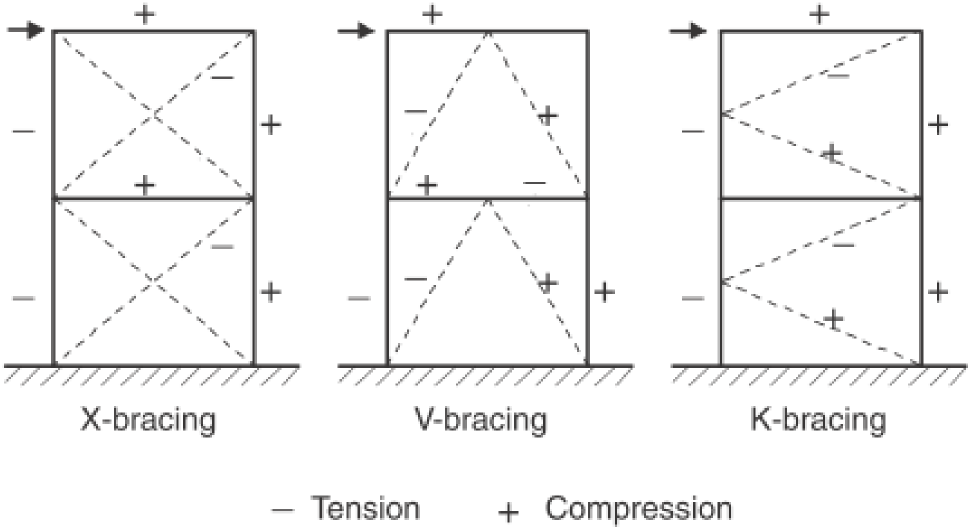

3.18 Different forms of bracing and their forces

3.19 X-bracing using CHS sections used at a sports centre in Hampshire (architect: Hampshire County Council)

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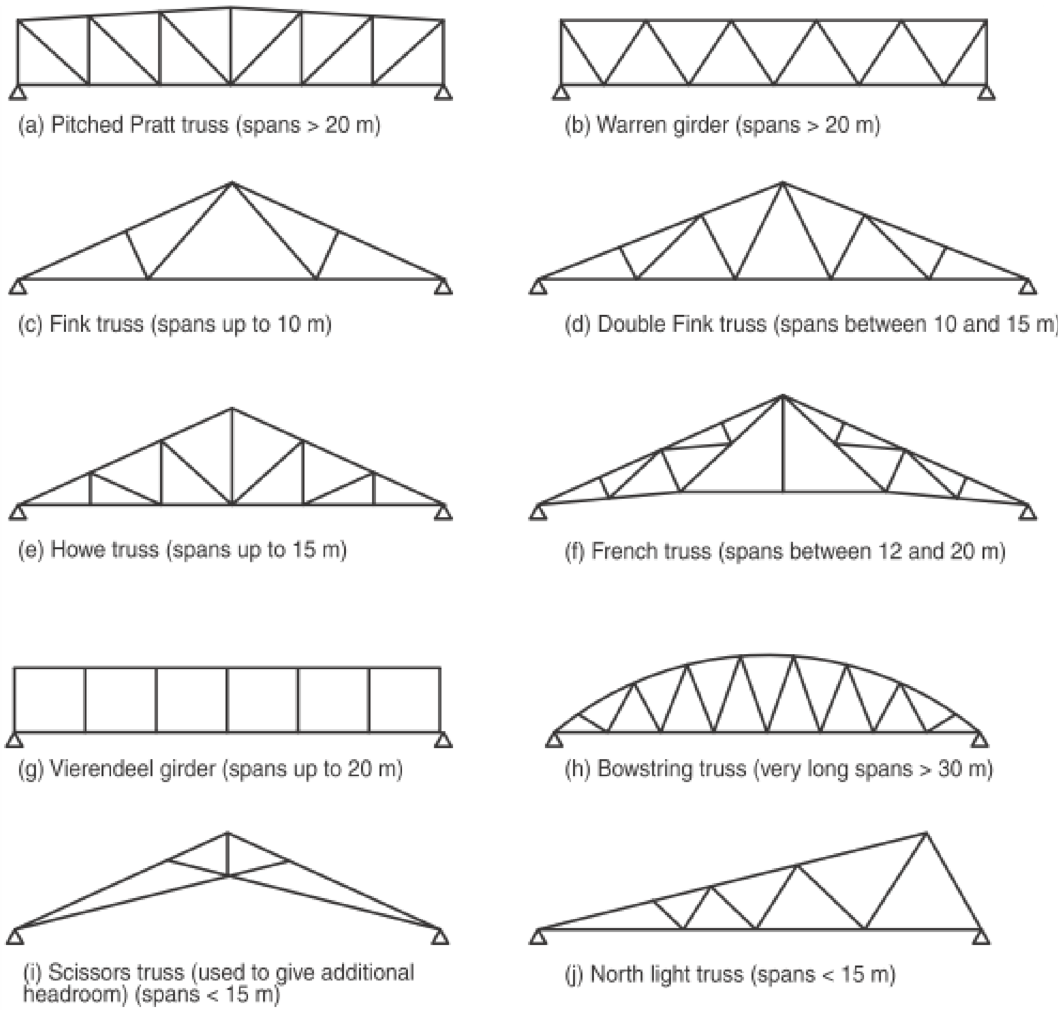
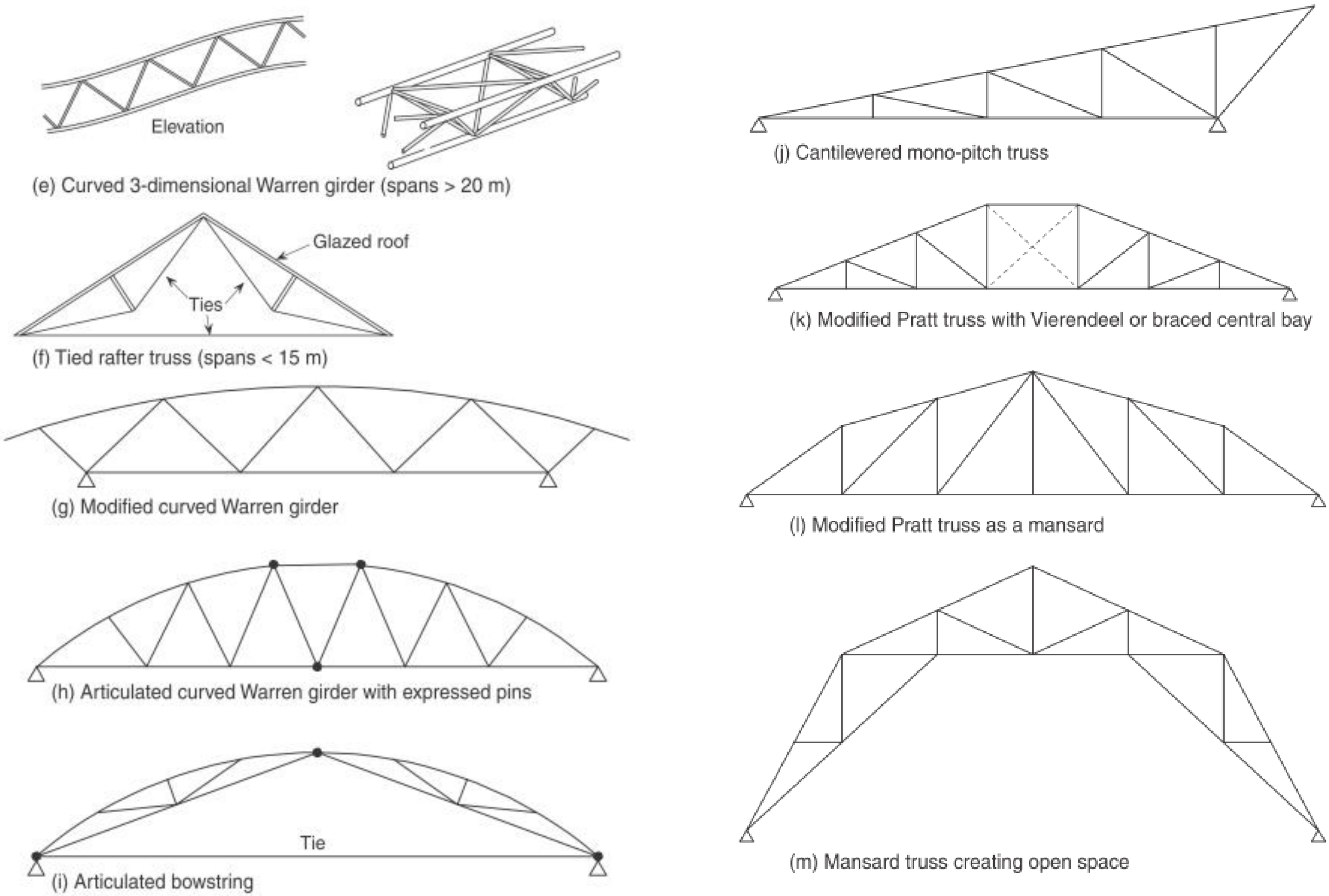


4.30 Different forms of conventional roof trusses and lattice girders

Architectural Design in Steel, P.Trebilcock, M.Lawson

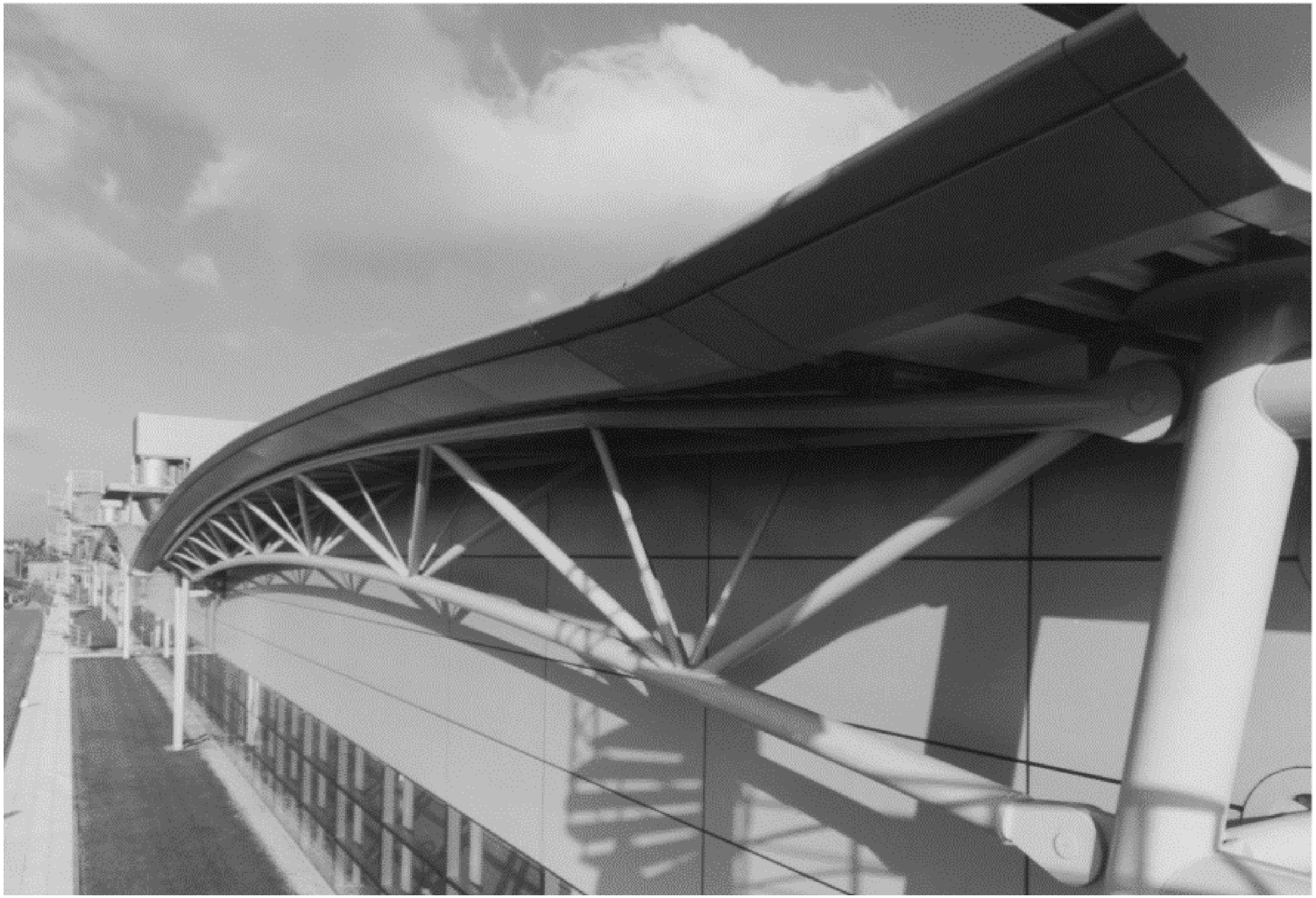


4.32 Development of standard truss and lattice forms

Architectural Design in Steel, P.Trebilcock, M.Lawson

4.33 Lattice girders combine with fabricated steel columns making a hybrid-portal structure at the Brit School, Croydon (architect: Cassidy Taggart)

Architectural Design in Steel, P.Trebilcock, M.Lawson



4.38 Curved triangular trusses at Swindon's Motorola factory (architect: Sheppard Robson)

Architectural Design in Steel, P.Trebilcock, M.Lawson

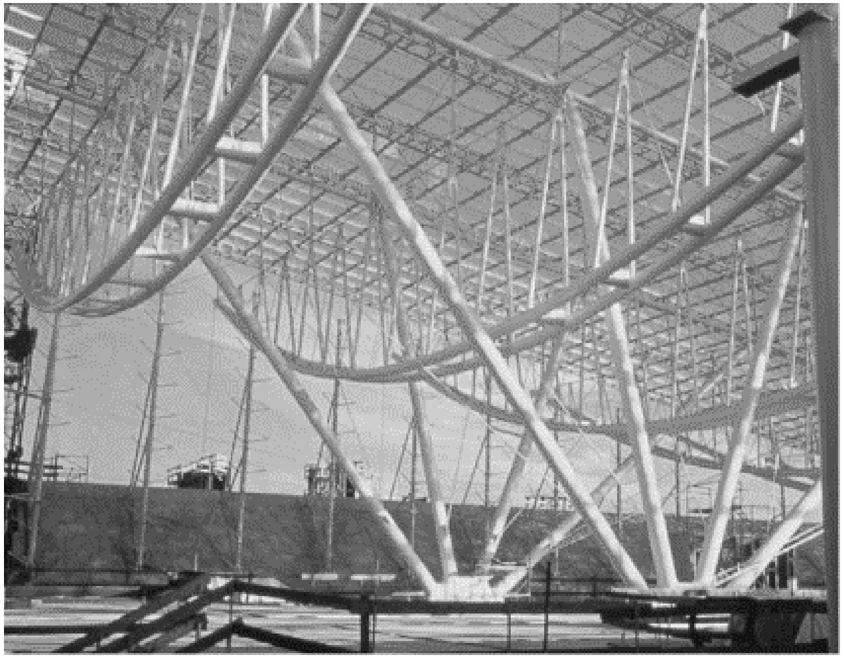
Figure 3.2

Mont-Cenis Academy, Herne, Germany, Jourda & Perraudin, 1999. A glazed box with an entry canopy.

Figure 3.4

Vertical trusses support the wall. Steel tension-only bracing in the wall planes is not photographed but is similar to that of the roof diaphragm bracing which is visible.

4.40 Stratford Market depot, London (architect: Wilkinson Eyre)



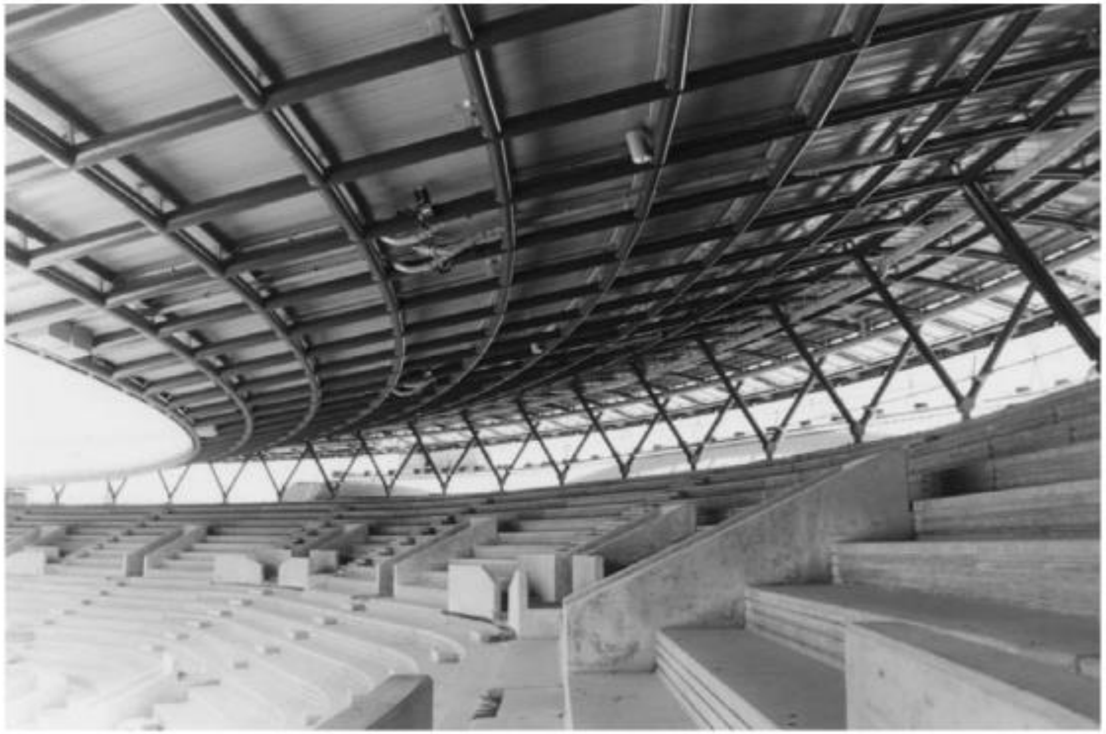
4.41 Deep curved roof trusses at the TGV terminal at Charles de Gaulle Airport, Paris (architect: Aeroports de Paris)

Architectural Design in Steel, P.Trebilcock, M.Lawson

4.22 Amsterdam's Schiphol Airport

4.23 Tubular columns and spine beams in Hong Kong's Hung Hom Station (architect: Foster and Partners)

Architectural Design in Steel, P.Trebilcock, M.Lawson



4.25 Tubular struts used to support the roof of Wimbledon No. 1 Court (architect: BDP)

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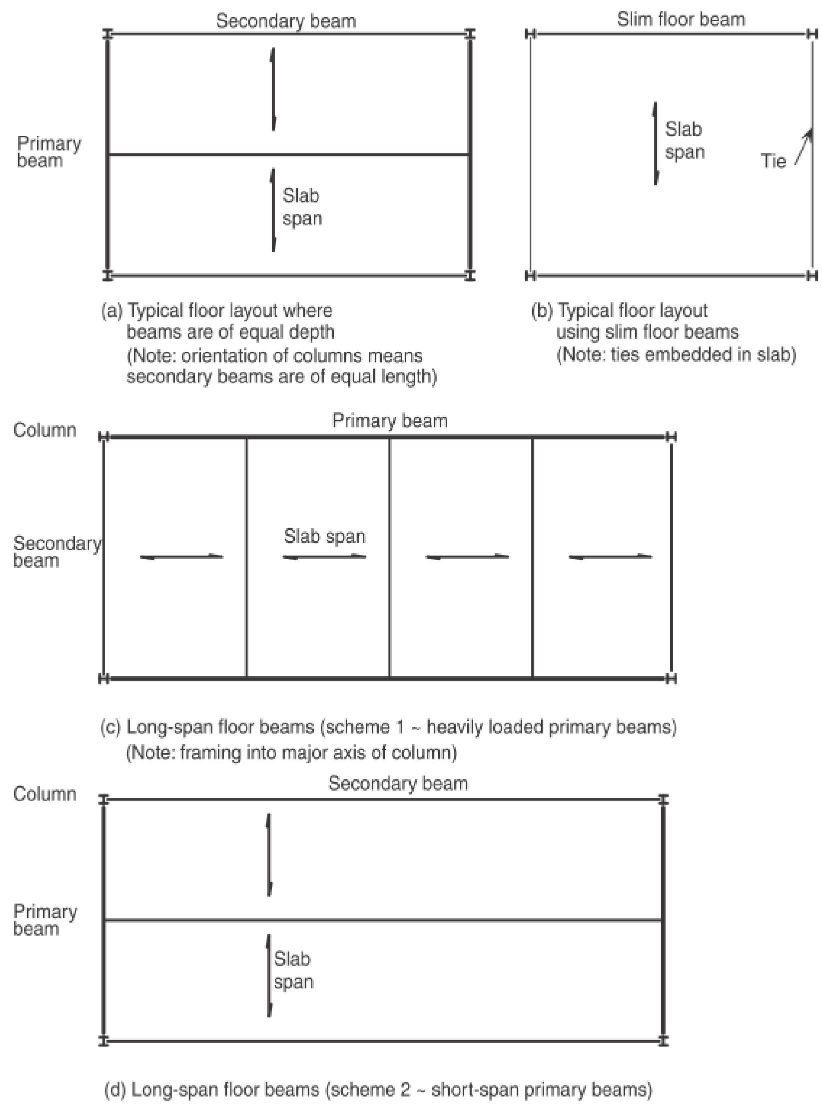

4.1 Typical floor-beam layouts for various spans

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